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Report on Canadian Achievements in Earth Observation

Summary

Space contributes in many ways to our ability to understand, manage and develop our environment and its resources. Data are collected in relation to water – oceans and inland waters –, land-cover, and the atmosphere and assist us in understanding and acting in a broad range of areas including climate change and disaster management.

Overview

Since its creation in 1989, the Canadian Space Agency (CSA) has set out to ensure that all Canadians learn and benefit from the innovations of space science and technology to the greatest extent possible. Its objectives are to support and promote a highly competitive space industry and address the needs of Canadian society. The CSA plays the lead role in the implementation of the Canadian Space Program (CSP). With almost half of Canada's GDP growth in the knowledge-intensive sectors of the economy, the CSP is a key driver behind niche leadership on the world stage, new opportunities for industry and scientists, and long-term socio-economic benefits for Canadians. In its implementation of the CSP, the CSA works in close partnership with a large number of federal government departments and agencies, including Natural Resources Canada (NRCan), the Canada Center for Remote Sensing (CCRS), the Canadian Forestry Service (CFS), Fisheries and Oceans Canada (DFO), Environment Canada (EC), the Meteorological Service of Canada (MSC), the Canadian Ice Service (CIS), Agriculture and Agri-food Canada (AAFC), and the Department of National Defence (DND). Information on the CSP and CSP-partners is available at: www.space.gc.ca

The year 2003 marks a significant milestone in Canada's Earth and Environment (E&E) activities. A number of events have shaped E&E activities in a lasting fashion, including the launch of Scisat-1, the initiation of a large number of multilateral, user-driven Earth Observation (EO) projects, the convening of the first Earth Summit of the world's leading spacefaring nations and the completion of the initial phase of the Global Monitoring for Environment and Security (GMES) program.

Scisat-1 is an all-Canadian science satellite and a symbol of Canadian scientific excellence. Scisat-1 also marks a renewed commitment to space science and atmospheric research in areas of global interest. It carries the Atmospheric Chemistry Experiment (ACE), which investigates the chemical processes that are involved in the distribution of ozone in the atmosphere. The ACE mission will work in conjunction with other instruments and missions planned by the National Aeronautics and Space Administration (NASA) in the U.S., the European Space Agency (ESA), and other international partners over the next decade to gain a better understanding of the chemistry and dynamics of the atmosphere that affect the Earth's protective

ozone layer. The analysis of the data will lead to a more informed assessment of international environmental policies such as the Montreal Protocol for the elimination of chlorofluorocarbons (CFCs).

A second significant achievement is the launch of a series of new initiatives under the CSA's Government Related Initiatives Program (GRIP). The activities have been defined multilaterally and focus on challenges facing Canadians at the national level. The new GRIP activities constitute a reaffirmation of the interest of other federal departments in space.

Finally, building on the success of recent initiatives such as the International Charter "Space and Major Disasters", the world's leading spacefaring nations met in Washington at an Earth Summit and created an ad hoc Group on Earth Observations. This Group was commissioned to develop a conceptual framework and implementation plan for building comprehensive, coordinated and sustained EO systems. At the same time, the European Union (EU) and European Space Agency (ESA) are forging a vision of how space assets can enable Global Monitoring for Environment and Security (GMES). The GMES program completed its initial phase in 2003 and begins its implementation period in 2004. These landmark commitments to promote collaborative use of space assets are characterised by newly affirmed high-level political support within the G-8 and other leading countries and may herald a change in the way international EO activities are developed.

Key Themes

The E&E Activities Report is presented according to key themes and includes detailed sections on new sensors and new technologies being pursued. Projects are underway in all of the key theme areas identified: oceans (ocean productivity, ocean dynamics and ocean surveillance), freshwater (lake, river and watershed management), land-cover (forestry, agriculture, habitat, the North and space-based wide area surveillance), climate change, atmospheric research and modelling and disaster management.

Significant achievements in relation to Oceans in 2003 include:

- Use of MERIS sensor for high-resolution ocean productivity measurement;
- "The Ocean's Pulse" project;
- MERIS and MODIS use study;
- I-STOP Project Charter for maritime surveillance;
- Operational surveillance "pilot projects" and extension of I-STOP coverage from Atlantic to West Coast and Gulf of St-Lawrence.

Significant achievements in relation to Freshwater in 2003 include:

- Report on watershed management;
- "Wealth of Water: wise watershed, lake and river systems management" project.

Significant achievements in relation to Land-cover in 2003 include:

- Earth observation for the sustainable development of forests (EOSD) land-cover mapping activities;
- EOSD research achievements relating to land-cover, change monitoring, biomass and automated processes;
- Development and validation of methodologies for delineating field management zones for variable rate applications, using both optical and radar data;
- Validation of methodologies to derive Leaf Area Index (LAI), leaf chlorophyll and leaf water content from hyperspectral data and use for improving forecasts of yield and maturity date;
- Compilation of a guide for end-user diagnostics for assessing polarimetric SAR data quality;
- Sensitivity assessment of backscatter from multiple polarizations to total volumetric canopy moisture;
- CSA-NRCan agreement to develop Northern geospatial information using RADARSAT and Landsat-7 data;
- Northern View Project kick-off;
- Parks Canada-NRCan initiative to improve ecosystem management and outreach programs using EO data;

- CCRS project with the Ontario Geological Survey to produce 60 1:100,000 satellite-based terrain image maps of Northern Ontario.

Significant achievements in relation to Climate change, atmospheric research and modelling, and disaster management in 2003 include:

- Launch of Scisat-1;
- Prolonged Odin/OSIRIS mission;
- Canadians leading ground segment research for International Living With a Star;
- Phase-A studies for Canadian contribution to Global Precipitation Mission and SWIFT;
- Developing mapping methodologies and algorithms and significant mapping activities;
- Developing a Crown Closure product (a forest biophysical parameter) based on LAI, clumping index, and land cover, to form the basis of a national environmental indicator;
- Demonstrating the feasibility to use medium resolution satellite imagery for mapping severe insect defoliation in boreal forests;
- Carbon cycle research;
- A broad range of ice and cryosphere related projects in both research and operational areas;
- Hurricane Watch activities in West Atlantic Basin and participation in the International Charter Space and Major Disasters.

Many of these projects rely on active Canadian participation in the space segment of existing or planned missions, including: Scisat-1, MOPITT on Terra, OSIRIS on Odin, International Living With a Star (ground segment lead), SWIFT on GOSAT, the Global Precipitation Measurement Mission (radar), Cloudsat, HYDROS, the enhanced Polar Outflow Probe, an operational hyperspectral mission (currently in phase A2), and a smallsat SAR program (phase A).

Technology Development

Technology development activities are focussed on: the hyperspectral and smallsat SAR missions. The CSA is continually pursuing new avenues of research to identify promising space technologies that offer innovative solutions to terrestrial challenges. Two critical activities currently being pursued are the development of hyperspectral sensing and applications technologies and the development of low-cost, small-satellite SAR systems.

The Advanced SAR Workshop, a bi-annual event to review the progress of advanced synthetic aperture radar (SAR) technology was held in June 2003 at CSA, with 94 speakers and over 180 participants from 15 different countries.

In addition, work has been undertaken to prepare for RADARSAT-2 data products. Once launched, RADARSAT-2 is expected to significantly improve our ability to monitor resources due to its resolution and multiples polarizations, particularly useful for crop monitoring. The launch is currently planned for 2005. RADARSAT-2 is critical to ensuring long-term data continuity in C-band for RADARSAT users.

Significant achievements in technology development in 2003 include:

- Phase A2 milestones for hyperspectral mission;
- Pre-phase A completed for smallsat SAR, including engineering model of membrane antenna and demonstration of concept feasibility;
- ASAR workshop;
- RADARSAT-2 preparation.

Infrastructure

Canada's ground segment infrastructure is currently being updated to enable RADARSAT-2 reception. This year, Canada began receiving ENVISAT-ASAR data.

The GRIP program has embarked on a series of new initiatives in cooperation with a wide range of other federal government departments. The joint investments underline the CSA's determination to increase operational use of space data in the delivery of mandates of government departments.

The Canadian Space Agency's Earth Observation Application Development Program (EOADP) supports industry initiatives to develop applications and markets. The program announced nine contracts in June 2003 for a value of over \$3 million.

The GeoConnections Discovery Portal was released this year and the underlying software was made available free of charge to all GeoConnections partners. It provides a discovery service for satellite imagery as well as for related geospatial products and services such as the Canadian Geospatial Data Infrastructure. Every day, over 1200 users access the GDP at www.ceonet.ccrs.nrcan.gc.ca.

Representatives from GeoConnections and the U.S. Federal Geographic Data Committee met to evaluate proposals from the fourth Canada-USA framework data request for proposals. This year's selected project is for the Gulf of Maine and involves multiple Canadian and U.S. government agencies and private companies. It will result in an integrated framework of the sea floor of the Gulf of Maine to be used by those interested in commercial and recreational fishing, marine sanctuaries and protected areas, fibre-optic and electric cable laying, ecotourism, mining, navigation and aquaculture.

Significant achievements in relation to the ground segment in 2003 include:

- Completion of the ENVISAT Advanced Synthetic Aperture Radar (ASAR) ground segment upgrades and commencement of ENVISAT ASAR operations;
- Substantive progress on RADARSAT-2 ground segment upgrades;
- Implementation of a LANDSAT-7 contingency plan using LANDSAT-5 Thematic Mapper™ data;
- New GRIP initiatives;
- EOADP contracts;
- GDP launch;
- Fourth Canada-USA framework project.

International Collaboration

Canada is a founding member of CEOS and continues to be as an active leader and member of Working Groups established to help CEOS meet its primary objectives.

Canada has engaged in a broad range of on-going international cooperation initiatives in 2003, including new ventures in the context of its ESA membership (GMES, TIGER and Northern View), SAR cooperation in the context of the Canada-Japan Space Panel, the signature with the Indian Space Research Organisation of a Memorandum of Understanding, numerous bilateral initiatives with NASA and participation in and hosting of the GOFC/GOLD Program and Secretariat.

The detailed Report aims to be a comprehensive source of Canadian EO achievements for the year 2003. We hope it will constitute a solid reference for you on Canadian activities and increase your appreciation of the vast contribution space assets are making to Earth and Environment activities in Canada and internationally.

For more information on these initiatives, please contact:

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